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IS 6695 (1998): Honey bees - Code for conservation and maintenance [FAD 3: Apiary Industry]



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“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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भारतीय मानक
मधुमक्खी — संरक्षण एवं पालन की संहिता
(पहला पुनरीक्षण)

Indian Standard
HONEY BEES — CODE FOR
CONSERVATION AND MAINTENANCE
(*First Revision*)

ICS 65.140

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Apiary Industry Sectional Committee had been approved by the Food and Agriculture Division Council.

The vast agriculture, horticulture and forest cover of the country coupled with overdominance of majority of rural population on agriculture and allied occupations offers beekeeping as one of the most important and potential subsidiary occupations. Beekeeping, initially was a forest based industry but with advancement in technology of bee management coupled with green revolution, it has been transformed into an agro-based industry.

While honey bees are known producers of honey, royal jelly, propolis and beeswax, they are primarily instrumental in increasing the productivity of a number of agricultural crops many folds through cross-pollination. Apart from increase in yield of different crops, they have been found to have improved the quality of seeds/fruits significantly.

Honey bees, therefore, constitute natural media for enhancing primary production and augmentation of national wealth. To facilitate better conservation of honey bees and growth of apiculture, this standard was published in 1972, covering the essential aspects of apiary management. The present revision, among others, incorporates the following changes:

- a) List of important plants, their species and flowering periods have been modified on the basis of the knowledge gained from research institutions.
- b) General recommendations for safe use of pesticides for honey bees have been included.

For guidance this standard also includes information regarding conservation of various species of honey bees (*see Annex A*).

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2:1960. 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

HONEY BEES — CODE FOR CONSERVATION AND MAINTENANCE

(First Revision)

1 SCOPE

This code prescribes essential aspects of apiary management for better conservation of honey bees and growth of apiculture and also covers requirements for healthy maintenance of honey bee colonies.

2 REFERENCES

The following Indian Standards contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	Title
460 (Part 1):1985	Specification for test sieves : Part 1 Wire cloth test sieves (<i>third revision</i>)
1504 : 1996	Beeswax, crude and refined (<i>third revision</i>)
1515 : 1998	Beehives — Specification (<i>third revision</i>)
1736 : 1980	Honey extractor, tangential type
2072 : 1977	Comb foundation sheets (<i>first revision</i>)
4028 : 1992	Beeswax, bleached for cosmetic industry (<i>third revision</i>)
4941 : 1994	Extracted honey (<i>second revision</i>)
5426 : 1969	Travelling bees box
5427 : 1969	Honey extractor, radial type
14522 : 1998	Honey processing unit — Technical requirements

3 PROCUREMENT OF COLONIES

3.1 Capturing or Purchase of Honey Bee Colonies

3.1.1 In order to maximize the scope for capturing honey bee colonies for rearing them in beehives, the natural nesting sites should be preserved or restored as far as possible and additional favourable nesting sites should be created at suitable forest locations.

3.1.2 Mere dependence on capturing natural colonies would reduce in due course, the natural bee population

in areas where beekeeping has taken roots. In order to avoid this situation, a planned programme of establishing bee nurseries should be encouraged.

3.1.3 If a colony is to be acquired through purchase, the seller shall declare the age of the queen and health of the colony. The beekeepers shall normally be expected to sell young queens, preferably less than one year old. For better survival of bees, it may be advisable to buy and sell colonies not less than 3 frames.

3.2 A colony infested with any of the notified diseases (*see Annex B*) shall not be sold, purchased or transferred from the hives, walls, pots, logs, etc.

3.3 If an area has been notified as epidemic region, inter-state or inter-regional migration from such area to other regions should be prohibited.

4 HIVING THE HONEY BEES

4.1 Honey bees should be colonized in beehives conforming to IS 1515. All other equipment should similarly conform to the relevant Indian Standards as far as possible.

4.2 Where wall hives are in use, these should accommodate movable standard frames depending upon the requirement of honey bee species.

5 APIARY MANAGEMENT

5.1 Apiary

A location where one or more honey bee colonies are assembled together and collectively managed may be considered as an apiary.

5.2 Site

An apiary site should be as close to a natural source of clean hygienic water and bee flora as possible, protected from wind, direct sunlight, severe heat, severe cold, rain, wild animals, ants, termites and exposures to insecticides or toxic fumes or poisonous chemicals. An apiary should not be located in unclean areas or at a site where the presence of bees is likely to cause public nuisance. It should be 5 m away from public path or highway.

5.3 Over Stocking

The number of honey bee colonies kept in such an apiary should be limited to optimum in relation to

forage resources within the same flight range, so as to avoid over stocking.

5.4 Periodic Cleaning

Beehives should be cleaned and periodically painted. Each colony should be periodically inspected once or twice in a month and in a manner causing least disturbance and provocation to honey bees. Debris accumulated on the bottom board should be collected in a container and incinerated. Pieces of wax combs should be pooled together and melted for wax recovery. Old combs should be melted and comb renewal induced.

5.4.1 Where colonies are over-wintered and packed, periodic cleaning should be dispensed with, during the packed period.

5.5 Brood Frames

All brood or full-depth frames should be wired to withstand breakage of combs during inspection, migration and extraction, etc. Comb foundation strips should conform to IS 2072 and their cell size should correspond with that prescribed for the locality/species of honey bee.

5.6 Keeping of Records

A beekeeper should keep a record indicating the condition of each of his colonies during periodic inspections. If he suspects incidence of any disease or undue mortality owing to pesticidal residues he should resort to remedial measures immediately.

5.7 Preventive and Curative Measures

A beekeeper should co-operate with the local agency by adopting prescribed preventive and curative measures against any epidemic or endemic bee diseases.

5.8 Feeding During Dearth Period

During the short intervals of local dearth periods, if there are no adequate honey and/or pollen stores within the colony, the beekeeper should provide sugar feeding or pollen supplements or both so as to maintain colony strength without letting the honey bee starve.

6 MIGRATION

6.1 If the local dearth period or periods are prolonged beyond 6 to 8 weeks continuously, the beekeeper should, if possible, migrate his colonies to the nearest sources of natural forage from farm(s) or forest(s) through individual or collective migration. The beekeepers may also migrate their colonies to avail of the natural flora in other localities, having different flora and different flowering periods.

6.2 Prior to migration all the colonies should be thoroughly examined for any deficiencies like queenlessness, presence of laying workers, food

shortage, etc, and such deficiencies should be rectified.

6.3 Colonies shall be packed so as to:

- a) secure in position various hive components, frames in particular;
- b) avoid shaking during transit;
- c) provide adequate ventilation to the bees;
- d) prevent congestion inside;
- e) provide feeding or water in transit, if necessary; and
- f) prevent honey bees escaping through gaps in entrance gates, and other components.

6.4 The migration should be done preferably at night or in cool weather avoiding adverse temperature. The colonies should be loaded with their frames parallel to the direction of movement in case of trucks and at right angles in case of train transport. Migration by air, rail or truck should be planned well in advance so as to avoid damage due to avoidable delay in transit (*see* IS 5426).

6.5 Proper arrangement like cleaning the apiary site, arranging hive stands, providing clean water should be done prior to the arrival of the colonies at the migratory site(s).

6.6 On arrival at the migratory site, the colonies should be promptly arranged on the hive stands and the entrance gates opened at the earliest appropriate hour.

6.7 The first post-migration inspection should be done within 7 days after the colonies settle down to work. During this inspection, it may be observed whether there are any combs broken, queens lost, bees dead, etc. The old combs which need immediate replacement should be taken to one side of the hive where the queen does not generally lay eggs. These old combs should be subsequently removed and wax recovered and the empty frames should be sterilized by dipping in hot water and should be dried in direct sun before giving foundation strips for comb renewal.

6.8 In addition to honey flow and pollination, this migration period can also be looked upon as an occasion for increase in the number of colonies by simple divisions or planned queen rearing programme. The superannuated queens should be replaced by young mated queens.

7 PRE-HONEY FLOW BUILD-UP

7.1 Colonies should be developed to their full strength by the beginning of the flow season by:

- a) uniting weak colonies;
- b) augmenting medium colonies with sealed brood combs and honey bees or both;
- c) giving stimulative feeding; and
- d) giving comb foundation strips for drawing combs and expanding brood nest.

7.2 Dummy or division boards should be used for colonies which still fall short of full strength by a couple of combs so as to induce them to the supers. The colonies which are still weak should be transferred to nuclei, to obtain some surplus honey yield.

8 HONEY FLOW

8.1 The moment nectar starts coming in, supers should be added to the colonies. When the first supers are more or less filled with honey but not sealed, a fresh super should be given in order to provide additional storing space. It may be desirable to have three supers for each colony in the apiary as the normal life of super combs is three years.

8.2 Honey should be extracted only when the combs are sealed by the honey bees. Extraction of unripe honey will lead to fermentation and spoilage.

8.3 Towards the end of the flow the brood rearing is reduced, and honey is often instinctively stored in the brood combs to provide for the ensuing local dearth. Therefore, honey should never be extracted from brood combs.

8.4 At the end of the flow, and after the honey has been extracted, the empty combs should be got cleared of honey bees and preserved carefully in supers in a cool, dry, rat-proof enclosures with suitable preservatives against wax moth and other insect pests. Such drawn out combs should be reused during the next honey flow. A beekeeper should equip himself with at least two supers of such drawn out combs for each colony in his apiary to derive maximum harvest from each honey flow.

9 EXTRACTION OF HONEY

9.1 Honey should be extracted only from sealed combs. Carbolic acid or excessive smoke or toxic fumes should not be used as it may taint the flavour of honey or otherwise spoil it.

9.2 Extraction should be done only in a clean, fly-proof enclosure. This will avoid honey bees visiting the extracted honey and drowning in it.

9.3 All the equipment used for extraction, like the uncapping knives, trays, extractors, etc, should be thoroughly cleaned in boiling water, before use. The extractors should conform to IS 1736 or IS 5427.

9.4 During extraction, the honey should run through a strainer of 1.40 mm [see IS 460 (Part 1)].

9.5 The containers used for collecting the extracted honey should preferably be of stainless steel, aluminium or if of other metal, should be thickly tinned or galvanized. The containers should have covers and each should preferably carry a label specifying the name of the beekeeper, date and place of extraction.

9.6 Persons engaged in extraction of honey should

be free from any contagious diseases, should wear clean clothes and should clean their hands with a disinfectant soap.

9.7 Honey extracted from colonies with infectious bee diseases should be kept separate and not mixed with general lot so as to avoid transmission of pathogenic micro-organisms through such honeys. This honey should be pasteurized before marketing. It should never be fed either in processed or unprocessed form to the bees.

9.8 The extracted honey in air-tight transit containers should be taken to the pooling and processing centres as early as possible. Even during the short interval, the honey remains with the beekeeper, it should be stored in cool, dry and hygienic place and should be protected from smoke, heat and insects.

9.9 Recommendations for proper pooling, hygiene processing and testing of honey are given in Annex C.

10 EXTRACTION OF BEESWAX

10.1 Since beeswax (see IS 1504 and IS 4028) is a valuable by-product finding use in various industries, every beekeeper should scrupulously collect every bit of such wax. This is usually obtained from the old combs during renewal, bits of bur and brace-combs, discarded pieces of combs and cappings on honey cells. Wax from *Apis cerana indica* and of *Apis mellifera* should be kept separate to enhance its market value.

10.2 Beeswax from cappings is the purest form of wax and, therefore, should be stored separately without mixing it with general recovery of beeswax in the apiary.

10.3 The old and discarded combs should be stored in containers with tight lids and should be melted at the earliest to avoid further deterioration and infestation with wax moth. These meltings should be cast in slabs of desired size, shape and mass.

11 CROP POLLINATION

11.1 A beekeeper should realize that besides harvesting honey and wax, he should also mobilize his honey bees for pollination of agricultural/horticultural crops to increase the agricultural productivity. He should, therefore, fully co-operate in individual or collective migration of honey bees to nearest farming areas suitable for this purpose.

11.2 Reciprocally, the farming communities should realize that particularly in case of self sterile crops, any amount of irrigation, fertilizer or cultural care cannot give him optimum yields if there are no honey bees to pollinate such crops. The farming community should, therefore, collectively protect the honey bees kept in their localities from theft, and pesticides, etc. If pesticides are sprayed a few days before flowering starts or if wind direction, etc, are considered while

applying them, the damage to honey bees can be minimized. There are insecticidal formulations which are relatively harmless to honey bees. These should be preferred as far as possible. Since bees fly anywhere within a radius of about one kilometer, the entire local farming community shall collectively care for the protection of bees kept in their locality for mutual benefits. The farming community should be suitably educated in this aspect. General recommendations for safe use of pesticides for honey bees are given in Annex D.

11.3 The village Panchayat or a community of farmers in a compact locality may provide for permanent well protected bee houses where optimum number of bee

colonies can be safely placed during annual recurring migration of bee stocks for pollination of their local crops to maximize their crop yields. These village bee houses should be registered as seasonal apiary sites.

12 CONSERVATION OF BEE FLORA

12.1 Viability of the beekeeping industry depends on the density and composition of local flora. Forest vegetation should not, therefore, be destroyed. Trees, shrubs and herbs providing bee forage should be particularly conserved. For guidance, a list of important plants suitable for apiculture is given in Annex E.

ANNEX A

(Foreword)

CONSERVATION OF VARIOUS SPECIES OF HONEY BEES

A-1 The little honey bee (*A. florea*) builds a small single comb exposed to light. It yields very meagre quantity of honey. But its wax is of a very high quality. These bees should not be disturbed or destroyed for such meagre honey harvests. Only the deserted empty combs should be collected for recovery of wax which should be kept separate in view of the superior quality of its wax. These bees selectively pollinate crop plants with small inconspicuous flowers. In fact, it has been observed that under hot tropical or sub-tropical conditions, the role of *A. florea* as crop pollinator is even more conspicuous than that of *A. cerana indica*. Their nests should be carefully preserved and suitable sites should be created to augment their nests in farms and forests.

A-2 The giant or Rock honey bee (*A. dorsata*) builds a very large single comb exposed to light. It is also a very efficient crop pollinator and the best yielder of honey and wax. However, due to its ferocious stinging habit, bee hunters collect their honey and wax by very crude destructive methods such as burning them. These bees should be protected against such destruction. Instead of burning them, smoke alone should be used to dislodge bees from their combs. Only a part of the honey store should be collected leaving adequate portion of honey for colony sustenance. Only the deserted empty combs should be used for wax recovery. Their nests should be protected and augmented unless

the nests are at inconvenient locations endangering human safety.

A-3 The honey bee, *A. cerana indica* builds a number of parallel combs in dark enclosure of trees and rock cavities. This is the only species of Indian bees which can be reared in modern movable frame beehives, in apiaries.

A-4 Italian honey bees, *A. mellifera* were introduced in this country in early seventies. It is highly productive because of its bigger size, longer flight range, higher colony population, quick breeding of colony and low absconding/swarming tendency. Otherwise it is similar in habits to the Indian honeybee as it builds a number of parallel combs in enclosed spaces gentle in behaviour and is similarly reared in modern movable frame hives.

A-5 'Dammar' or Indian stingless honey bees (*Melipona* spp, and *Trigona* spp.) construct their nests in hollows of trees, rocks or walls. They are the smallest of the honey yielding bees. They yield very meagre quantities of honey and inferior wax. But they increase national wealth by selectively pollinating certain agricultural and forest plants with very small inconspicuous flowers normally ignored by *Apis* spp. Their nests should, therefore, be carefully preserved and the stingless bees should be encouraged to build new nests at suitable sites in farms and forests.

ANNEX B

(Clause 3.2)

LIST OF NOTIFIABLE HONEY BEE DISEASES

B-1 AMERICAN FOUL BROOD (A. F. B.)

B-1.1 Cause

It is a larval honey bee disease caused by bacterium known as *Bacillus larvae* (White). It infects the gut

of the larvae.

B-1.2 Gross Symptoms

Larvae invariably die in sealed stage, putrefy and become slimy and sticky with foul odour.

B-1.3 Spread

Through exchange of honey bees and infected materials, swarms, drifting, etc.

B-1.4 Treatment

Antibiotics.

B-2 EUROPEAN FOUL BROOD (E. F. B.)**B-2.1 Cause**

It is a larval bee disease initially caused by the bacterium known as *Streptococcus pluton* (White) and secondarily infected by *Bacterium eurydice*. It infects the gut of the larvae.

B-2.2 Gross Symptoms

B-2.2.1 Larvae die mostly in early stage before sealing.

B-2.2.2 Generally no conspicuous odour.

B-2.3 Spread

Through exchange of combs or other hive components, etc.

B-2.4 Treatment

Antibiotics, preferably Terramycin.

B-3 ACARINE DISEASE**B-3.1 Cause**

It is an adult bee disease caused by a microscopic

mite *Acarapis woodi* (Rennie). It infects the trachea (breathing tubes) in thorax.

B-3.2 Spread

B-3.2.1 From old infested honey bees to young honey bees through direct contact or through drifters or swarms, mixing or exchange of adult honey bees.

B-3.3 Treatment

B-3.3.1 Use of acaricides like chlorobenzylate.

B-4 NOSEMA DISEASE**B-4.1 Cause**

It is an adult honey bee disease caused by the protozoan *Nosema apis zander*. It infects the gut of the adult.

B-4.2 Gross Symptoms

B-4.2.1 Inability to fly, dysentery, paralytic movements.

B-4.3 Spread

B-4.3.1 Through unhygienic conditions of colony, and exchange of materials of infected colonies particularly the combs and also through excreta of honey bees.

B-4.4 Treatment

B-4.4.1 Fumigation of combs and hive parts with acetic acid or formalin.

B-4.4.2 Drug treatment of fumagillin (antibiotic).

ANNEX C

(Clause 9.9)

POOLING, HYGIENE PROCESSING, TESTING AND PACKING OF HONEY

C-1 POOLING AND HYGIENE

C-1.1 At the pooling and processing centres, each lot of honey received should be subjected to rapid preliminary physiochemical tests like flavour, specific gravity, turbidity, etc, before it is pooled in larger air-tight bulk containers, preferably of capacities 100 kg each.

C-1.2 Since honey collected by the beekeepers is pooled at a central place by beekeepers' co-operative societies and other similar authorized organizations, these should have a separate honey house for all these operations. Such a unit should be suitably and functionally designed.

C-1.3 The honey house should be situated on an

elevated, well drained site to preclude any possibility of percolation of water in basement. It should be away from the main township to minimize the problem of proximity to municipal drainage, town dumps, effluents, flies, air pollution, etc, and should preferably be isolated from main highways of traffic lines and dust.

C-1.4 There should be ample availability of filtered and chlorinated potable water.

C-1.5 There should be full basement with separate rooms for (a) unprocessed bulk honey, and (b) processed honey in various categories of packages.

C-1.6 The honey house should be completely fly-proof and also well lighted and ventilated. All the

entrances should carry double doors. A fly-proof toilet room should be provided, with hygienic arrangements and well separated from the main pooling and processing unit. It should have water-flush connected to drainage main or a septic tank with a soak-pit for its effluent.

C-1.7 All persons employed in pooling, processing and packing of honey should keep personal hygiene, be free from any communicable diseases and should be periodically inoculated against cholera, typhoid, etc.

C-2 PROCESSING

C-2.1 In order to have lowest possible storage temperature, the processed and unprocessed honeys should invariably be stored in basement only. Storage of honey at higher room temperature increases its hydroxymethyl-furfural contents and should therefore be prevented.

C-2.2 In order to prevent fermentation and retard granulation, honey should be processed appropriately before it is marketed. Honey should be filtered through strainers of 500 and 300 micron [see IS 460 (Part 1)] before processing. In order to facilitate easy straining, the honey should be pre-heated in a water-bath to a temperature not exceeding 37°C to 43°C.

C-2.3 Care should be taken to heat the honey:

- a) indirectly through a water-bath,
- b) in a closed system to retain its natural aroma and flavour, and

c) uniformly at controlled temperature in order to kill the yeasts that cause fermentation. For guidance, honey may be heated uniformly at 60°C for 20 min or at 63°C for 15 min. The clean filtered honey should thus be processed in a 'Honey Processing Unit' (see IS 3891).

C-2.4 The processed honey should be run through a filter to remove any remaining finer impurities. This filtered honey should be allowed to settle in a series of settling tanks before it is packed for market. This helps to get clearest honey as any fine suspensions like wax come up to the surface in these settling tanks.

C-3 TESTING

C-3.1 The processed honey should be tested for various characteristics before it is packed (see IS 4941).

C-3.2 Stocks of honey known or suspected to be fermented, spoilt or contaminated with disease pathogens, drugs, poisonous pollen or such other ingredients harmful to human health, should not be released for human consumption.

C-4 PACKING

C-4.1 The honey should be packed for marketing in air-tight hygienically clean, wide mouthed, glass containers or in acid-resistant lacquered tin containers or in suitable food grade polyethylene containers.

ANNEX D

(Clause 11.2)

GENERAL RECOMMENDATIONS FOR SAFE USE OF PESTICIDES FOR HONEY BEES

Pesticides commonly applied on various crops may be hazardous to the honey bees because they visit flower for nectar and pollen. The lethal effects of pesticides should be minimized by applying comparatively safe chemicals in a proper manner and at the right time. Evenings are safe periods for the application of the insecticides. Following may be kept in view while applying pesticides.

- a) Seed treatment or soil application of pesticides is safe for bees.
- b) Spraying should be preferred to dusting as

spraying allows bees drifting to adjoining fields and wild flowers.

- c) Aerial spraying should be avoided in areas where there are bee farms; alternatively colonies should be shifted to safe places.
- d) Granular application of pesticides is safer than spraying. Spraying on leaves before emergence of flowers is safer.
- e) Efforts should be made to minimize drift of the pesticides. Foliar spraying before flowers opens are safe.

ANNEX E

(Clause 12.1)

LIST OF IMPORTANT PLANTS SUITABLE FOR APICULTURE

E-0 There are a number of cultivated and wild herbs, shrubs and trees from which honey bees collect pollen and nectar. However, with a view to help in selection of such plants on which bees thrive well, and which would be suitable for cultivation and help in selecting location of apiaries, a list has been compiled.

E-0.1 It is intended that for facilitating faster and healthier growth of apiculture, the information given in this annex would also encourage selective cultivation of plants according to their suitability in various areas. However, due to various ecological conditions, a plant which may be an important source in one region may not be so in other regions.

E-0.2 This annex includes botanical names and

classification, and flowering periods of important cultivated and wild herbs, shrubs and trees suitable for apiculture as sources of nectar or pollen or both.

E-1 CULTIVATED PLANTS

The botanical names, classification, and flowering periods of cultivated herbs, shrubs and trees are given in Table 1.

E-2 WILD PLANTS

The botanical names, classification, and flowering period of wild herbs, shrubs and trees are given in Table 2.

Table 1 Cultivated Plants

(Clause E-1)

In col 4 and 5, '+' indicates plants known to be useful, '+1' minor sources, '+2' medium sources (average) and '+3' major sources.

Botanical Name (1)	Common English Name (2)	Family (3)	Bee Forage		Flowering (Month No.) (6)
			Pollen (4)	Nectar (5)	
<i>Allium Cepa</i> L.	Onion	Alliaceae	+	+	2-5
<i>Althaea rosea</i> Cav.	Hollyhock	Malvaceae	+1	+	2-6
<i>Antigonon leptopus</i> Hk. & Arn.	Pink vine	Polygoanceae	+2	+2	7-2
<i>Brassica</i> spp.	Mustards	Brassicaceae	+3	+3	9-12
<i>Caianus cajan</i> (L.) Mil sp.	Pigeon pea	Papillionaceae	+	+3	9-10
<i>Carthamus tinctorius</i> L.	Safflower	Compositae	+1	+1	3-5
<i>Calosia argentea</i> L.	Cockscomb	Amaranthaceae	+1	+	3-8
<i>Coriandrum sativum</i> L.	Coriander	Umbelliferae	+3	+3	10-4
<i>Cosmos bipinnatus</i> Cav.	Cosmos	Asteraceae (Compositae)	+2	+2	3-11
<i>Corocus sativus</i> L.	Saffron Crocus	Iridaceae	+1	+1	10-11
<i>Crucifarious</i> Vegetables, etc.	Raddish, Cabbage Knol Kohl, etc.	Brassicaceae	+2	+2	10-3
<i>Cucurbits</i>	Courds and Cucumbers	Cucurbitaceae	+	+1	4-10
<i>Fagopyrum asculentum</i> Moench	Buckwheat	Polygonaceae	+2	+2	7-9
<i>Foeniculum vulgare</i> Mill.	Fennel	Apiaceae (Umbelliferae)	+	+	1-4

Table 1 (Continued)

Botanical Name	Common English Name	Family	Bee Forage		Flowering (Month No.)
			Pollen	Nectar	
(1)	(2)	(3)	(4)	(5)	(6)
<i>Gossypium</i> spp.	Cotton	Malvaceae	+	+	8-10
<i>Guizotia abyssinica</i>	Niger seed	Compositae	+3	+2	10
<i>Helianthus annuus</i> L.	Common sunflower	Compositae	+2	+3	4-11
<i>Helianthus dubius</i> L.	Sunflower	Compositae	+	+	7-10
<i>Impatiens Balsamina</i> L.	Garden	Balsaminacea	+2	+1	8-10
<i>Ipomoea learii</i> paxt.	Blue Dawn Flower	Convolvulacea	+2	+1	8-10
<i>Linum usitatissimum</i> L.	Flax	Linaceae	+	+	1-3
<i>Musas paradisiaca</i> L.	Plantain	Musaceae	+	+	1-12
<i>Nriganum vulgare</i> L.	Wild Marjoram	Lamiaceae	+	+	8-9
<i>Papaver</i> spp.	Poppy	Papaveraceae	+2	+	1-4
<i>Pennisetum typhoides</i> (Burm.) Stepf & Hubb.	Pearl Millet (Bajra)	Poaceae (Gramineae)	+1		6-10
<i>Penstemon barbatus</i> Nutt.	—	Sorophulariaceae	+1	+1	6-7; 12-1
<i>Phlox drummondii</i> Hk.f.	Drummond Phlox	Polemoniaceae	+1		6-8; 12-2
<i>Portulaca grandiflora</i> Hk.	Rose Moss	Portulacaceae	+3	—	5-10
<i>Raphanus sativus</i> L.	Radish	Brassicaceae	+2	+2	2-4
<i>Sesamum indicum</i> L.	Sesame	Podaliaceae	+3	+3	6-9
<i>Solidago canadensis</i> L.	Goldenrod	Asteraceae	+2	+2	4-6; 9-10
<i>Trifolium</i> spp.	Clover	Papilionaceae	+	+3	4-6
<i>Zee mays</i> L.	Maize	Poaceae	+3	—	6-9
<i>Zinnia elegans</i> Jacq	Youth and old age	Asteraceae	+	+	5-11
<i>Zinnia linearis</i> Benth.	—	Asteraceae	+	+	

SHRUBS

<i>Rerberis</i> spp.	Barberry	Berberidaceae	+3	+3	2-6
<i>Callistemon</i> spp.	Bottle brush	Myrtaceae	+1	+2	3-4; 10-2
<i>Coffea</i> spp.	Coffee	Rubiaceae	+	+2	2-4
<i>Euphorbia pulcherrima</i> Wild	Poinsettia	Euphorbiaceae	+	+	11-12
<i>Hamelia patens</i> Jacq.	The spreading Hamelia	Rubiaceae	+	+2	—
<i>Ricinus communis</i> L.	Castor-oil-plant	Euphorbiaceae	+2	—	10-4
<i>Rosa</i> spp.	Rose	Rosaceae	+1	+	1-12
<i>Adanasonia digitata</i> L.	Monkey-bread tree	Bombacaceae	+2	+2	1-3

Table 1 (Concluded)

Botanical Name	Common English Name	Family	Bee Forage		Flowering (Month No.)
			Pollen	Nectar	
(1)	(2)	(3)	(4)	(5)	(6)
<i>Anacardium occidentale</i> L.	Cashew	Anacardiaceae	+	+	11-3
<i>Annona</i> spp.	Custard-apple	Annonaceae	+1		5-7
<i>Areca catechu</i> L.	Areca Nut	Arecaceae	+	+	1-12
<i>Cassia</i> spp.	Senna	Caesalpiniaceae	+		3-7
<i>Casuarina equisetifolia</i> L.	Horsetail tree	Casuarinaceae	+2	—	—
<i>Citrus</i> spp.	Lemon, orange, etc.	Rutaceae	+2	+2	2-5
<i>Cocos nucifera</i> L.	Coconut	Arecaceae (Palmae)	+3	+	1-12
<i>Delonix regia</i> (Boj.) Rafin.	Flamboyant (Gul-mohar)	Caesalpiniaceae	+3	+	4-11
<i>Diospyros kaki</i> L.f.	Kaki	Ebenaceae		+	
<i>Duranta repens</i> L.	Golden dewdrop	Verbenaceae	+		4-7
<i>Eriobotrya japonica</i> (Thunb.) Lindl.	Loquat	Rosaceae		+	10-11-3
<i>Eucalyptus</i> spp.	Gum tree	Myrtaceae		+3	12-5
<i>Gliricidia sepium</i> (Jacq.) Walp.	Madre	Papilionaceae		+	1-4
<i>Hevea brasiliensis</i> (HBK.) Muell Arg.	Para rubber tree	Euphorbiaceae	+	+3	3-4
<i>Lagerstroemia indica</i> L.	Crape-myrtle	Lythraceae	+3		3-7
<i>Lagerstroemia speciosa</i> (L.) Pers.	Queen Crapemyrtle	Lythraceae	+2		5-6
<i>Ligustrum vulgare</i> L.	Common Privet	Oleaceae		+	2-4
<i>Litchi chinensis</i> (Gaertn) Sonnert.	Litchi	Sapindaceae		+3	2-3
<i>Mimusops elengi</i> L.	Ilanjy	Sapotaceae	+	+	5-6
<i>Moringa</i> spp.	Drumstick tree	Moringaceae	+1	+1	11-2
<i>Peltophorum pterocarpum</i> (DC.) backer ex Heyne	Brasilatto	Caesalpiniaceae	+2		12-6
<i>Prosopis</i> spp.	Mesquite	Mimosaceae	+	+	4-12
<i>Prunus</i> spp.	Stona fruits	Rosaceae	+2	+2	2-4
<i>Psidium guajava</i> L.	Guava	Myrtaceae	+2	+2	4-9
<i>Punica granatum</i> L.	Pomegranate	Punicaceae	+	+	4-5
<i>Malus pumila</i> Mill.	Apple	Rosaceae	+2	+2	3-5
<i>Salix babylonica</i> L.	Weeping willow	Salicaceae	+	+	2-3
<i>Tamarindus indica</i> L.	Tamarind	Caesalpiniaceae	+	+3	5-7
<i>Thespesia populreae</i> Soland.	Portia tree	Malvaceae	+	+	10-1

Table 2 Wild Plants

(Clause E-2)

In col 4 and 5, '+' indicates plants known to be useful, '+1' minor sources, '+2' medium sources (average) and '+3' major sources.

Botanical Name	Common English Name	Family	Bee Forage		Flowering (Month No.)
			Pollen	Nectar	
(1)	(2)	(3)	(4)	(5)	(6)

HERBS					
<i>Brugmansia candida Pers.</i>	—	Solanaceae	+2	—	5-8
<i>Centratherum</i> spp.	Iron weed	Asteraceae	+2	+2	10-11
<i>Cyanotis</i> spp.	—	Commelinaceae	+2	—	8-10
<i>Dysophylla salicifolia Dalz.</i>	Gomani	Labiatae	+2	—	11-2
<i>Eupatorium</i> spp.	Thoroughwort	Compositae	+2	+2	1-3
<i>Impatiens</i> spp.	Snapweed	Balsaminaceae	+2	+2	8-10
<i>Lagascea mollis Cav.</i>	—	Astoraceae	+2	+	8-10
<i>Leucas stelligera Wall.</i>	—	Labiatae		+2	8-11
<i>Oxalis corniculata L.</i>	Wood sorrel	Oxalideceae	—	+2	5-9
<i>Paracaryum malabaricum clarke</i>	Malori	Boraginaceae	+	—	8-10
<i>Polygonum</i> spp.	Knotweed	Polygonaceae	+	+	7-10
<i>Phyla nodiflora (L.) Greene</i>	—	Verbenaceae	—	+2	—
<i>Senecio dalzellii Clarke</i>	—	Asteraceae	+1	+1	10-11
<i>Taraxacum officinale Weber</i>	Common Dandelion	Asteraceae	+1	+1	3-6
<i>Trifolium</i> spp.	Clover	Papilionaceae	+	+1	3-9
SHRUBS					
<i>Berberis aristata DC.</i>	Barberry	Berberidaceae	+	+3	2-6
<i>Berberis lycium Royle</i>	Barberry	Berberidaceae	+	+3	2-6
<i>Carissa carandas L.</i>	Karanda	Apocynaceae	+1	+1	6-9
<i>Carvia callosa (Nees) Bremek</i>	Karvi	Acanthaceae	+2	+3	8-10
<i>Elaeagnus Latifolia L.</i>	—	Elaeagnaceae	+2	+2	2-3
<i>Euphorbia neriifolia L.</i>	—	Euphorbiaceae	+1	+2	1-2
<i>Lepidagathis cuspidata Nees</i>	—	Acanthaceae	+3	+3	1-3
<i>Nilgirianthus reticulatus (Stapf.) Bremek</i>	—	Acanthaceae	+2	+2	9-10
<i>Plectranthus rugosus Wall.</i>	Shain	Labiatae	+	+3	8-10
<i>Pogostemon parviflorus Benth.</i>	—	Lamiaceae	+	—	2-3

Table 2 (Continued)

Botanical Name	Common English Name	Family	Bee Forage		Flowering (Month No.)
			Pollen	Nectar	
(1)	(2)	(3)	(4)	(5)	(6)
<i>Pyracantha crenulata</i> (D. Don) Roem.	—	Rosaceae	+	+	—
<i>Rubus</i> spp.	Brambles	Rosaceae	+2	+3	3-5
<i>Schefflera Wallichiana</i>	Doddabettu	Araliaceae	+3	+3	4-5
<i>Scutia circumsissa</i> (L.F.) Radlk.	—	Rhamnaceae	+1	+1	1-2
<i>Synadenium grantii</i> Hk.f.	African Milk bush	Euphorbiaceae	—	+1	11-2
<i>Thelepaepale ixicocephala</i> (Benth.) Bremek.	—	Acanthaceae	+3	+3	10-1
<i>Vitex</i> spp.	—	Verbenaceae	+2	+2	12-6
<i>Wendlandia thyrsoides</i> (Roem. & Schult.) Steud.	—	Rubiaceae	+2	+2	2-3
TREES					
<i>Acacia sinuata</i> (Lour.) Merr.	Soap pod Wattle	Mimosaceae	+1	+1	2-3
<i>Acacia nilotica</i> (Linn.) Dsl. subsp. <i>indica</i> (Benth.) Brenan	Indian Gum Arabic	Mimosaceae	+2	—	7-9
<i>Actinodaphne angustifolia</i> Nees	Pisa	Lauraceae	+3	+3	12-3
<i>Aegle marmelos</i> (L.) Corr.	Bael tree	Rutaceae	+2	+2	6
<i>Ailanthus excelsa</i> Roxb.	Coromandel Ailanto	Simaroubeaceae	+	—	12
<i>Alseodaphne semecarpifolia</i> Nees		Lauraceae	+3	+3	12
<i>Apodytes beddomei</i> Mast.	False Holey	Icacinaceae	+3	—	3-4
<i>Azadirachta indica</i> A. Juss.	Neem tree	Meliaceae	—	+2	3-5
<i>Bombax ceiba</i> L.	Red Silk Cotton tree	Bombacaceae	+2	+1	1-3
<i>Boerhaavia flabellifera</i> L.	The Palmyra Palm	Arecaceae	+2	—	12
<i>Butea monosperma</i> (Lamk.) Taub.	Dhak tree	Papilionaceae	—	+1	1-3
<i>Calophyllum inophyllum</i> L.	Common Poon	Clusiaceae	+	—	6; 11-12
<i>Canthium parviflorum</i> Lamk.	Common honey horn	Rubiaceae	—	+2	4-5
<i>Cassia fistula</i> L.	Indian Laburnum	Cesalpiniaceae	+2	+2	5-6
<i>Cinnamomum zeylanicum</i> Bl.	Common Cinnamon	Lauraceae	+	+	12-1

Table 2 (Continued)

Botanical Name (1)	Common English Name (2)	Family (3)	Bee Forage		Flowering (Month No.) (6)
			Pollen (4)	Nectar (5)	
<i>Dalbergia sissoo</i> Roxb.	Sissoo	Papilionaceae	—	+2	2-6
<i>Dillenia pentayna</i> Roxb.	Dog teak	Dillaniaceae	+1	+1	3-4
<i>Dospyros</i> spp.	Ebony	Ebenaceae	—	+2	3-4
<i>Ehretia acuminata</i> R.Br.	Ivory Wood	Ehretiaceae	—	+2	4
<i>Elasocarpus</i> spp.	Bracelet Tree	Elaeocarpaceae	+2	+2	—
<i>Emblica officinalis</i> Gaertn.	Gooseberry tree	Euphorbiaceae	+2	+2	3-5
<i>Erythrina indica</i> Lamk.	Common Coral tree	Papilionaceae	+2	+2	2-3
<i>Flacourtia indica</i> (Burm.f.) Merr.	Sweet thorn	Flacourtiaceae	+2	+2	2-3
<i>Flacourtia montana</i> Grah.	Sweet thorn	Flacourtiaceae	+2	+2	11-12
<i>Garuga pinnata</i> Roxb.	Balsam tree	Burseraceae	+	+	3-6
<i>Grewia asiatica</i> L.	Indian Lindenberry	Tiliaceae	+1	+2	—
<i>Holigarna grahamii</i> (Wt.) Hk.f.	Black Varnish	Anacardiaceae	+2	—	1-2
<i>Hopea wightiana</i> Wall.	Common Caung	Dipterocarpaceae	—	+1	3-6
<i>Limonia acidissima</i> L.	Elephant apple	Rutaceae	+	+1	2-3
<i>Syzygium</i> <i>caryaphyllatum</i> (L.) Alston	Clove-like black plum	Myrtaceae	—	+2	4-5
<i>Syzygium zeylanicum</i> (L.) DC.	Ceylon Jaumoon	Myrtaceae	—	+2	2-4
<i>Lagerstroemia</i> <i>lanceolata</i> Wall. ex Wt. & Arn.	Crape Myrtle	Lythraceae	+2	+2	4-5
<i>Ligustrum perrottetii</i> A.DC	Privet	Oleaceae	+1	+1	10
<i>Litsaea stocksii</i> Hk.f.	Betel nut laurel	Lauraceae	+1	+1	10-11
<i>Madhuka indica</i> Gmel.	Common Mohwah	Sapotaceae	—	+3	1
<i>Mallotus philippensis</i> (Lamk.) Muell. Arg.	Kamala dye	Euphorbiaceae	+3	—	9
<i>Mammea suriga</i> (Buch - Ham. ex Roxb.) Kosterm.	Fragrant Poon	Clusiaceae	+3	—	2-3
<i>Memecylon umbellatum</i> Burm.f.	Bilberry	Malastomataceae	+1	—	2-3
<i>Morinda</i> spp.	Morinda	Rubriaceae	—	+1	—
<i>Olea dioica</i> Roxb.	Indian Wild Olive	Oleaceae	+1	—	2-3
<i>Pegnamia pinnata</i> (L.) Pierre	Indian Beech	Papilionaceae	+2	+3	3-5
<i>Premna coriacea</i> Clarke	Firebrand Teak	Varbenaceae	+	+3	4-5

Table 1 (Concluded)

Botanical Name	Common English Name	Family	Bee Forage		Flowering (Month No.)
			Pollen	Nectar	
(1)	(2)	(3)	(4)	(5)	(6)
<i>Prunus cerasoides</i> D. Don.	Himalayan Cherry	Rosaceae	+	+	11
<i>Salix tetrasperma</i> Roxb.	Indian Willow	Salicaceae	+2	—	10-11
<i>Sapindus mukerossi</i> Gaertn.	Soap nut	Sapindaceae	+	+3	5-6
<i>Sapindus laurifolius</i> Vahl	Soap nut	Sapindaceae	+	+3	10-1
<i>Strychnos nux-vomica</i> L.	Strychnine tree	Strychnaceae	+	—	3-4
<i>Strychnos potatorum</i> Willd.	Clearing nut	Strychnaceae	+	—	4-5
<i>Symplocos beddomei</i> Clarke	—	Symplocaceae	+	—	11-2
<i>Syzygium comini</i> Skeels	Common Jaumoon	Myrtaceae	+2	+3	4-6
<i>Terminalia alata</i> Var. <i>nepalensis</i> fern.	—	Combretaceae	+	+3	4-6
<i>Terminalia arjuna</i> Wt. & Arn.	Winged Myrobalan (Mathi)	Combretaceae	+	+3	4-6
<i>Terminalia bellerica</i> (Gaertn.) Roxb.	Belleric Myrobalan	Combretaceae	+	+3	4-5
<i>Terminalia chebula</i> Retz.	Chebolic Myrobalan	Combretaceae	+	+3	4-5
<i>Toona ciliata</i> Roem.	Toon	Meliaceae	+1	+3	3-5
<i>Vateria indica</i> L.	White Dammar	Dipterocarpaceae	+2	+2	2-4
<i>Xeromphis spinosa</i> (Thunb.) Kesy	Common Emetic Nut	Rubiaceae	—	+2	4-5
<i>Ziziphus mauritiana</i> Lamk. K.	Indian Palum/ Ber	Rhamnaceae	+2	+2	9-11
<i>Ziziphus rugosa</i> Lamk. K.	—	Rhamnaceae	+2	—	1-3

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This Indian Standard has been developed from Doc: No. FAD 3 (561).

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